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A NEW APPROACH TO AVOID BUCKLING IN BPSG BY USING
AN INTERMEDIATE BARRIER LAYER

ABSTRACT

5 A method is disclosed for reducing the effects of buckling, also referred to as cracking or wrinkling in multilayer heterostructures. The first step of the present method involves forming a planarization layer superjacent a semiconductor substrate. The planarization layer comprises tungsten, titanium, tantalum, copper, aluminum, single crystal silicon, polycrystalline silicon, amorphous silicon, borophosphosilicate glass ("BPSG") or tetraethylorthosilicate ("TEOS"). Next, a barrier film having a structural integrity is formed superjacent said planarization layer by exposing said substrate to a gas and radiant energy. The gas comprises a reactive or inert gas or mixture thereof, including at least one of N₂, NH₃, O₂, N₂O, Ar, Ar-H₂, H₂, GeH₄, and a Fluorine based gas, while the radiant energy generates heat substantially within the range of 500°C to 1250°C. Subsequently, a second layer is formed superjacent the barrier film. The second layer comprises tungsten, titanium, tantalum, copper, aluminum, single crystal silicon, polycrystalline silicon, amorphous silicon, borophosphosilicate glass ("BPSG") or tetraethylorthosilicate ("TEOS"). Finally, the substrate is heated sufficiently to at least a temperature of approximately 700°C to cause the planarization layer to expand according to a first thermal coefficient of expansion, the second layer to expand according to a second thermal coefficient of expansion, and the structural integrity of the barrier film to be maintained. This results in the barrier film isolating the planarization layer from the second layer, thereby preventing the

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planarization layer and the second layer from interacting during the heating step. Further, it enables the planarization layer to go through a solid state reaction and the second layer to obtain a uniform reflow.